

## REPORT DOCUMENTATION PAGE

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**Final Technical Report**  
**Defense University Instrumentation Research Program**

**Grant Number F49620-97-1-0191**

**A Vacuum Apparatus for Investigating Cathode Activity  
and Beam Formation in High Current Density Electron Guns**

**Sponsored by**  
**Air Force Office of Scientific Research/NE**

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## Final Technical Report

The equipment purchased with the 1997 DURIP contract # F49620-97-1-0191 is listed below.

Equipment and Vendor	Cost
Excimer Laser Lambda Physik	\$109,549
Barium and Strontium Cathode Assemblies for Plasma Deposition ACI Alloys	\$9742
Latitude CPI Computer Dell Computer	\$4,856
Microway Screamer Workstation Microway	\$7,863

The total cost of the above items is \$132,010.

The Lambda Physik LPX 210 excimer laser is currently being installed in the oxide cathode laboratory. Its primary purpose is to produce a plasma that is deposited on a nickel cathode base. In this capacity it replaces a completely unreliable vacuum arc plasma gun. The laser will be used to produce emission coatings for high performance oxide cathodes. Coatings of barium and strontium deposited in an oxygen atmosphere will produce a low work function emission surface. Given the very clean environment in the deposition chamber and the absence of binders or other contaminants in the deposition process, the resulting cathodes are expected to have emission densities in excess of 100 A/cm<sup>2</sup>.

The laser will also be used to deposit metalization on the surface of high performance ceramics. Very high purity alumina ceramics are very difficult to metalize. Using a laser plasma deposition process, metalization of a variety of technical ceramics should be possible. Success would make available a wide range of technical ceramics for use in microwave tubes.

RF breakdown studies have suggested that treatment of high gradient surfaces with a laser beam may significantly increase the threshold field for breakdown. The laser will be used to modify the surface characteristics of RF breakdown electrodes. If the results are successful, the laser treatment may replace many hours of conditioning that are normally required to process a high gradient component.

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The cathode deposition experiment uses metallic barium and strontium in the plasma gun to produce the emission layer. Both these materials decompose when exposed to water vapor. In order to use the metallic barium it was necessary to design a very thin nickel sleeve to seal the metal surfaces from exposure to water. The barium and strontium cathode assemblies were used in the plasma gun deposition process and will continue to be used in the laser deposition experiments.

Both the computers are used in the modeling and simulation of RF components and RF-beam interactions in klystrons. The Microway Alpha based workstation is also used to run ANSYS 3-D thermal and stress analysis simulations for the microwave tubes and components.

The support of the US Air Force is greatly appreciated. The above equipment is critical to the research on microwave sources currently being conducted at Stanford.